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Claim

An express method for diagnosing subclinical mastitis, comprising the steps of irradiating milk in a milk pipeline by light of complicated spectral composition and varying the values of photoelectric currents proportional to transmission factors for a light flux passing through a layer of milk, characterized in that, in order to improve efficiency of the method and determine the main kinds of its pathogens in the process of milking, the light flux passing through the milk is dispersed by passing it through optical filters into several spectral fluxes having wave lengths of 0.6 to 2.0 μ , and the levels of transmission factors for light energy of corresponding wave lengths is then assessed by means of a measuring system.

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For Patents And Trademarks

(12) APPLICATION FOR INVENTION RIGHTS

(54) METHOD AND APPARATUS FOR QUANTITATIVE DETECTION OF PARTICLES
IN LIQUID MEDIA

1. An apparatus for quantitative particle determination in media, said apparatus comprising: an emitter set comprising one or more light emitters, alternately emitting one or more measuring light signals; a detector set comprising one or more light detectors sensitive to the output of the light emitters, characterized in that during analysis of a sample, the detector set receives the measuring light signals from a plurality of discrete sample light signal paths between the emitter and detector sets; the detector set provides the output values which can be evaluated by a processor means for providing a value indicative of the medium particle content.

2. The apparatus as claimed in claim 1, characterized in that the detector set is arranged to detect at least one set of scattered or reflected light signals due to reflectance by particles present within the medium.

3. The apparatus as claimed in claim 1, characterized in that it comprises an optical feedback means comprising a feedback detector, whose output provides for at least one of the following functions: control of either or both the voltage and current of at least one light emitter to maintain the emitter light output at a predetermined level; control of the sensitivity of at least one light detector to match the light output of at least one light emitter; and outputting the

signal available for a processor means and used for correction in providing a value indicative of the particle content.

4. The apparatus as claimed in claim 3, characterized in that said feedback detector comprises a light emitter of substantially the same type and characteristics as the light emitter whose output it controlled.

5. The apparatus as claimed in any one of claims 1 to 3, characterized in that said measuring light signal paths differ from each other by at least one of the following characteristics: a path length through the medium sample being analyzed, and a relative path angle through the medium sample being analyzed.

6. The apparatus as claimed in any one of claims 1 to 3, characterized in that one or more measuring light signals are within the infrared region of the electromagnetic spectrum.

7. The apparatus as claimed in claim 6, characterized in that one or more measuring light signals have a wavelength in the regions 750-1200 nm or 3000-10000 nm.

8. The apparatus as claimed in any one of claims 1 to 3, characterized in that a light emitter comprises a light emitting diode (LED).

9. The apparatus as claimed in any one of claims 1 to 3, characterized in that a light detector comprises a photo diode, light emitting diode (LED), photo transistor, or other opto-electronic device.

10. The apparatus as claimed in any one of claims 1 to 3, characterized in that it contains an emitter set comprising a plurality of light emitters positioned at different positions along a wall of a measuring cell, or positioned to be present along a wall or walls of an inserted measuring cell, the output of the light emitters being directed in such a way as to create a plurality of substantially straight light paths to one or more detectors of the detector set.

11. The apparatus as claimed in claim 10, characterized in that said emitters are arranged in a substantially radial manner around a substantially curved measuring cell, or cell holder.

12. The apparatus as claimed in claim 10, characterized in that it contains a plurality of groups of emitter set and detector set pairs, each group of emitter and detector sets functioning substantially independently of other groups, although the output of each detector set being considered by a processor means when providing a value indicative of particle presence within the sample medium being analyzed.

13. The apparatus as claimed in any one of claims 1 to 3, characterized in that the output of at least one light emitter is pulsed during analysis of a sample.

14. The apparatus as claimed in claim 12 comprising a plurality of pulsed light emitters and characterized in that the detector set, or an individual detector of the detector set, detects substantially the output of a single light emitter, or combination thereof, at a time during analysis of a sample; the pulsing of said light emitters being synchronized to allow the detection of the output of individual light emitters, or groups thereof.

15. The apparatus as claimed in any one of claims 1 to 3, characterized in that the output of at

least one light emitter is varied in its output intensity during analysis of a sample.

16. The apparatus as claimed in claim 15, characterized in that the detector set, or an individual detector of the detector set, produces a signal available for evaluation by a processor means at more than one output intensity of said light emitter(s).

17. The apparatus as claimed in any one of claims 1 to 3, characterized in that at least one detector of the detector set is positioned and operated to receive at least one signal during analysis of a sample which comprises purely reflected or scattered light, and not to receive directly transmitted light, from one or more emitters of the emitter set.

18. The apparatus as claimed in any one of the preceding claims, characterized in that the output of the detector set is converted to a digital format.

19. The apparatus as claimed in claim 18, characterized in that data is prepared into packets which are available to a processor means for evaluation in producing a value indicative of particle presence within a sample medium.

20. The apparatus as claimed in any one of the preceding claims, characterized in that it contains a processor means for producing one or more values indicative of the presence of particles within a sample medium.

21. The apparatus as claimed in claim 20, characterized in that said processor means compares values produced by the detector set with stored calibration reference values, the comparison producing values indicative of the presence of one or more different types of particles within a

sample medium.

22. The apparatus as claimed in claim 20, characterized in that the stored values comprise calibration data relating to chosen standards.

23. The apparatus as claimed in claim 20, characterized in that the comparison of data is based on either or both linear regression or Fourier transformations.

24. The apparatus as claimed in any one of claims 1 to 3, characterized in that it includes, or is configured to include, a measuring cell capable of allowing a continuous flow of a sample medium therethrough.

25. A method of quantitative determination of the presence of particles in a medium, wherein the apparatus as claimed in any one of claims 1 to 23 is used.

26. A method of determining the flow rate of a medium, wherein the apparatus as claimed in any one of claims 1 to 23 is used.

27. A method of quantitative determination of the levels of one or more different particles in a medium, wherein one or more light signals are transmitted into a medium sample, the measuring signals from a plurality of measuring light signal paths are detected, and the detected output is transmitted for subsequent evaluation by a processor means.

28. The method as claimed in claim 27, characterized in that the detected light signals differ from each other by at least one of the following characteristics: a path length through the

medium sample being analyzed; a relative path angle through the medium sample being analyzed; the output intensity of the emitter producing said signal; the proportion of transmitted to reflected or scattered light, and wavelength.

29. The method as claimed in any one of claims 27 to 28, characterized in that the detected output is compared by either or both of linear regression and Fourier transform analysis with stored calibration reference values to produce values indicative of the quantitative levels of one or more different types of particles within said medium.

30. A method as claimed in any one of claims 27 to 28, characterized in that the light signals are pulsed.

31. A method as claimed in claim 30, characterized in that the operation of emitter(s) and detector(s) is coordinated to allow the collection of light signals from different combinations thereof.

32. A method as claimed in any one of claims 27 to 28, characterized in that at least one light signal comprises light within the infrared portion of the electromagnetic spectrum.

33. A method as claimed in any one of claims 27 to 30, characterized in that the particle levels are determined in at least one of the following media: milk and dairy based fluids; substances containing fat particles, globules, and suspensions; blood, plasma, semen, urine and other biological fluids; oils and lubricants, and inks, paints, and liquid pigments.

34. The method as claimed in claim 33 when applied to milk and dairy based fluids,

characterized in that the method is used to indicate the levels of at least one of the following constituents: fat, protein, lactose, and somatic cells.